Scanning Electron Microscopy (SEM) photographs of biofilms and mineral alteration products from R/V Atlantis AT39-01 in the North Pond CORK Sites U1382A, U1383C from 2011-2017

Website: https://www.bco-dmo.org/dataset/756152
Data Type: Cruise Results
Version: 1
Version Date: 2019-02-22

Project
» Collaborative Research: Completing North Pond Borehole Experiments to Elucidate the Hydrology of Young, Slow-Spread Crust (North Pond 2017)

Program
» Center for Dark Energy Biosphere Investigations (C-DEBI)

Contributors	Affiliation	Role
Orcutt, Beth N.	Bigelow Laboratory for Ocean Sciences	Principal Investigator
D'Angelo, Timothy	Bigelow Laboratory for Ocean Sciences	Co-Principal Investigator
Biddle, Mathew	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Coverage

Spatial Extent: **N**:22.80221333 **E**:-46.05277 **S**:22.755885 **W**:-46.08151833
Temporal Extent: 2011-10-12 - 2017-10-22

Dataset Description

A collection of SEM imagery in .tiff format are available at the following urls. The size of each package is provided in parenthesis after the url. The file name of each package corresponds to the SampleIdentification field found in the data file through the Get Data button at the top of the page.

https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (14M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (13M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (38M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (7.6M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (24M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (6.2M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (26M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (6.2M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (27M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (12M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (14M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (12M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (19M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (16M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (21M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (6.2M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (3.8M)

https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (3.2M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (6.0M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (11M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (1.3M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (10M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (9.2M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (34M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (33M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (40M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (30M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (45M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (26M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (3.1M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (44M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (37M)
https://datadocs.bco-dmo.org/docs/302/North_Pond_2017/data_docs/756152/1... (18M)

Methods & Sampling

Polished mineral chips were prepared and deployed as described in Edwards et al. 2012 (DOI: 110.2204/iodp.proc.336.109.2012). Mineral colonization experiments were recovered during cruise AT39-01 in October 2017 and processed as described in Orcutt et al. 2011 (DOI: 10.1038/ismej.2010.157). Mineral chips were preserved in cold 4% paraformaldehyde in 1XPBS buffer, rinsed with 1XPBS, and then stored at -20ºC in a 1:1 mixture of 1XPBS:ethanol. Chips were serially dehydrated in the ethanol baths of increasing concentration for 10 minutes each, immersed in 100% hexodimethylsilane for 10 minutes, and air dried for 48 hours. Dehydrated chips were then mounted on SEM stubs, sputter coated with gold, and imaged on a Zeiss Supra25 field emission scanning microscope (SEM).

Data Processing Description

BCO-DMO Processing Notes:
- zipped all image subfolders into individual packages based on the Sample Identification text string
- modified parameter names to conform with BCO-DMO naming conventions
- added conventional header with dataset name, PI name, version date

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Data Files

File
log.csv (Comma Separated Values (.csv), 6.08 KB) MD5:86db6d8bd1e0a965259902226add6b97 Primary data file for dataset ID 756152

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Related Publications

Edwards, K. J., Wheat, C. G., Orcutt, B. N., Hulme, S., Becker, K., Jannasch, H., … Klaus, A. (2012). Design and deployment of borehole observatories and experiments during IODP Expedition 336, Mid-Atlantic Ridge flank at North Pond. Proceedings of the IODP. doi:10.2204/iodp.proc.336.109.2012
Methods

Orcutt, B. N., Bach, W., Becker, K., Fisher, A. T., Hentscher, M., Toner, B. M., … Edwards, K. J. (2010). Colonization of subsurface microbial observatories deployed in young ocean crust. The ISME Journal, 5(4), 692–703. doi:10.1038/ismej.2010.157
Methods

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Parameters

Parameter	Description	Units
SampleIdentification	Identification label of mineral colonization experiment	unitless
RockType	Type of rock substrate in mineral colonization experiment	unitless
DeploymentLocation	CORK borehole observatory Hole number (U1382A; U1383B; or U1383C) and horizon within the borehole observatory (wellhead; shallow; shallowEnriched)	unitless
File_count	number of Scanning Electron Microscopy (SEM) files for each experiment	count
Latitude	latitude (north) of CORK borehole observatory	decimal degrees
Longtitude	longitude (east) of CORK borehole observatory	decimal degrees
WaterDepth	meters of water depth to the seafloor where the CORK borehole observatory sits	meters (m)
DeploymentType	location (wellhead or downhole) within the CORK borehole observatory where the experiment took place	unitless
FluidDepth	average depth (in meters below seafloor) where crustal fluids are sourced for the experiment	meters (m)
DeploymentDate	date of the experiment deployment	unitless
RecoveryDate	date of the experiment recovery	unitless
package_url	web url to the zip file of images for the specified sample identification value.	unitless

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Instruments

Dataset-specific Instrument Name	Zeiss Supra25 field emission scanning microscope
Generic Instrument Name	Scanning Electron Microscope
Dataset-specific Description	Zeiss Supra25 field emission scanning microscope
Generic Instrument Description	A scanning electron microscope (SEM) scans a focused electron beam over a surface to create an image. The electrons in the beam interact with the sample, producing various signals that can be used to obtain information about the surface topography and composition.

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Deployments

AT39-01

Website	https://www.bco-dmo.org/deployment/723337
Platform	R/V Atlantis
Report	http://datadocs.bco-dmo.org/docs/Subseafloor_Microbial_Carbon_Cycling/data_docs/North_Pond_2017_Expedition%20Report_FINAL.pdf
Start Date	2017-10-02
End Date	2017-11-02

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Project Information

Collaborative Research: Completing North Pond Borehole Experiments to Elucidate the Hydrology of Young, Slow-Spread Crust (North Pond 2017)

Website: http://www.darkenergybiosphere.org/research-activities/field-sites/

Coverage: North Pond, Mid-Atlantic Ridge flank CORKs

NSF Award Abstract:
Seawater circulates through the upper part of the oceanic crust much like groundwater flows through continental aquifers. However, in the ocean this seawater circulation, many times heated by buried magmatic bodies, transports and releases 25% of the Earth's heat. The rate of fluid flow through ocean crust is estimated to be equal to the amount of water delivered by rivers to the ocean. Much of what we know of this subseafloor fluid flow comes from studies in the eastern Pacific Ocean on ocean crust created by medium and fast spreading mid-ocean ridges. These studies indicate that seawater and its circulation through the seafloor significantly impact crustal evolution and biogeochemical cycles in the ocean and affect the biosphere in ways that are just now beginning to be quantified and understood. To expand this understanding, this research focuses on fluid flow of seafloor generated by slow spreading ridges, like those in the Atlantic, Indian and Arctic Oceans because it is significantly different in structure, mineralogy, and morphology than that formed at fast and intermediate spreading ridges. This research returns to North Pond, a long-term; seafloor; fluid flow monitoring site, drilled and instumented by the Ocean Drilling Program in the Atlantic Ocean. This research site was punctured by boreholes in which fluid flow and geochemical and biological samplers have been deployed for a number of years to collect data and samples. It also provides resources for shipboard and on-shore geochemical and biological analysis. Broader impacts of the work include sensor and technology development, which increases infrastructure for science and has commercial applications. It also provides training for students and the integration of education and research at three US academic institutions, one of which is an EPSCoR state (Mississippi), and supports a PI whose gender is under-represented in sciences and engineering. Public outreach will be carried out in conjunction with the Center for Dark Energy Biosphere Investigations.

This project completes a long-term biogeochemical and hydrologic study of ridge flank hydrothermal processes on slow-spreading, 8 million year old crust on the western flank of the Mid-Atlantic Ridge. The site, North Pond, is an isolated northeast-trending sediment pond, bounded by undersea mountains that have been studied since the 1970s. During Integrated Ocean Drilling Program Expedition 336 in 2011 and an expedition five months later (2012), sensors, samplers, and experiments were deployed in four borehole observatories drilled into the seafloor that penetrated into volcanic crust, with the purpose of monitoring changes in hydrologic properties, crustal fluid composition and mineral alteration, among other objectives. Wellhead sampling in 2012 and 2014 already revealed changes in crustal fluid compositions; and associated pressure data confirm that the boreholes are sealed and overpressured, reflecting a change in the formation as the boreholes recover from drilling disturbances. This research includes a 13-day oceanographic expedition and use of on-site robotically operated vehicles to recover downhole instrument packages at North Pond. It will allow the sampling of crustal fluids, recovering pressure data, and measuring fluid flow rates. Ship- and shore-based analyses will be used to address fundamental questions related to the hydrogeology of hydrothermal processes on slow-spread crust.

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Program Information

Center for Dark Energy Biosphere Investigations (C-DEBI)

Website: http://www.darkenergybiosphere.org

Coverage: Global

The mission of the Center for Dark Energy Biosphere Investigations (C-DEBI) is to explore life beneath the seafloor and make transformative discoveries that advance science, benefit society, and inspire people of all ages and origins.

C-DEBI provides a framework for a large, multi-disciplinary group of scientists to pursue fundamental questions about life deep in the sub-surface environment of Earth. The fundamental science questions of C-DEBI involve exploration and discovery, uncovering the processes that constrain the sub-surface biosphere below the oceans, and implications to the Earth system. What type of life exists in this deep biosphere, how much, and how is it distributed and dispersed? What are the physical-chemical conditions that promote or limit life? What are the important oxidation-reduction processes and are they unique or important to humankind? How does this biosphere influence global energy and material cycles, particularly the carbon cycle? Finally, can we discern how such life evolved in geological settings beneath the ocean floor, and how this might relate to ideas about the origin of life on our planet?

C-DEBI's scientific goals are pursued with a combination of approaches:

(1) coordinate, integrate, support, and extend the research associated with four major programs—Juan de Fuca Ridge flank (JdF), South Pacific Gyre (SPG), North Pond (NP), and Dorado Outcrop (DO)—and other field sites;
(2) make substantial investments of resources to support field, laboratory, analytical, and modeling studies of the deep subseafloor ecosystems;
(3) facilitate and encourage synthesis and thematic understanding of submarine microbiological processes, through funding of scientific and technical activities, coordination and hosting of meetings and workshops, and support of (mostly junior) researchers and graduate students; and
(4) entrain, educate, inspire, and mentor an interdisciplinary community of researchers and educators, with an emphasis on undergraduate and graduate students and early-career scientists.

Note: Katrina Edwards was a former PI of C-DEBI; James Cowen is a former co-PI.

Data Management:
C-DEBI is committed to ensuring all the data generated are publically available and deposited in a data repository for long-term storage as stated in their Data Management Plan (PDF) and in compliance with the NSF Ocean Sciences Sample and Data Policy. The data types and products resulting from C-DEBI-supported research include a wide variety of geophysical, geological, geochemical, and biological information, in addition to education and outreach materials, technical documents, and samples. All data and information generated by C-DEBI-supported research projects are required to be made publically available either following publication of research results or within two (2) years of data generation.

To ensure preservation and dissemination of the diverse data-types generated, C-DEBI researchers are working with BCO-DMO Data Managers make data publicly available online. The partnership with BCO-DMO helps ensure that the C-DEBI data are discoverable and available for reuse. Some C-DEBI data is better served by specialized repositories (NCBI's GenBank for sequence data, for example) and, in those cases, BCO-DMO provides dataset documentation (metadata) that includes links to those external repositories.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536539

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